

Inpatient Diabetes Guidelines

Definitions

1. **Type 1 DM:** autoimmune. Patients require exogenous insulin to prevent DKA.
2. **Type 2 DM:** insulin resistance and a relative insulin deficiency. Treatment may be with diet, exercise, oral meds, injectable meds, and/or insulin. With severe insulin deficiency, patients also develop DKA.

Physiologic Insulin Regimen

All patients have basal, nutritional, and correctional requirements that must be met with endogenous insulin or with insulin provided to them.

Basal: insulin needed even when the patient is not eating (to control gluconeogenesis).

- Use glargine (q24, typically at bedtime, preferred for type 1), NPH (qHS or qAM+HS), detemir (BID or q24 for larger doses), or a continuous insulin infusion.

Nutritional: insulin to cover carbohydrate intake from food, dextrose in IVF, tube feeds, TPN.

- Use rapid-acting insulin (aspart, lispro, or glulisine) or short-acting insulin (regular).

Correctional: insulin given to bring a high blood glucose level down to target range (130-150 pre-meal and 180-200 before bedtime).

- Use rapid-acting insulin (aspart, lispro, or glulisine) or short-acting insulin (regular).

General Rules

- **Remember that a patient with type 1 DM will *always* need exogenous basal insulin, even if NPO. Failure to do so will lead to DKA.**
- Using correctional ("sliding scale") insulin alone is acceptable for initial titration but should be reevaluated daily.
- Order a carbohydrate controlled meal plan. Each meal contains 60 to 75 grams of carbohydrates.
- Check blood glucose (BG) before meals and at bedtime, +/- at 2am (if suspect hypoglycemia) in a patient who is eating; check BG q 4 or q 6 hours in a patient who is NPO or is receiving continuous tube feeds or TPN.
- Involve the diabetes educator, nurse specialist and dietician.

- Supply glucose meter, lancets, test strips, syringes/pen needles, insulin, glucose tablets, and glucagon kit as discharge prescriptions, if needed. Health insurance dictates which types of supplies will be covered.
- Oral medications: often, oral diabetes medications are held upon admission to the hospital. Hospitalized patients have the potential for renal impairment and tissue hypoxia or need IV contrast, and these are all contraindications to metformin use. Sulfonylureas should generally be held upon admission if you anticipate NPO status due to high risk of hypoglycemia. If patient's status improves and is reliably stable, consider restarting non-insulin medications.
- Nutritional insulin: regular is given within 30 min before meal, rapid-acting within 15 minutes before meal.
- Infection and glucocorticoids increase insulin needs; renal insufficiency decreases insulin needs.
- Total daily dose of insulin needed: type 1 patients require approximately 0.5 units/kg/day; type 2 patients vary in their insulin resistance and may require from 0.5 to 2 units/kg/day.

Hypoglycemia Protocol

- BG <70 mg/dL: if patient is alert and taking PO, give 20 grams of oral fast-acting carbohydrate either as glucose tablets or 6 oz. fruit juice. If the patient cannot take PO, give 25 mL D50 IV push.
- Check BG every 15 minutes and repeat above treatment until BG is ≥ 100 mg/dL.

Insulin Regimens

- The guidelines below may assist with initial determination and subsequent adjustment of insulin doses.
- Reevaluate insulin doses on a daily basis.

Correctional insulin (rapid or short acting): select between sensitive, average, or resistant based on BMI.

- Sensitive: BMI <20, or <50 units/day.
- Average: BMI 25-30, or 50-90 units/day.
- Resistant: BMI >30, or >90 units/day.

Nutritional insulin (rapid or short acting): continue with home nutritional doses, or can start based on meal consumption and titrate up as necessary. Remember to adjust and increase nutritional dosing as you observe daily insulin requirements. Example:

- Not eating: 0 units pre-meal dose.
- Eating <50% of meals: 1 unit pre-meal dose.
- Eating 50-75% of meals: 2 units pre-meal dose.
- Eating >75% of meals: 3 units pre-meal dose.

Insulin regimen for a patient controlled only with diet at home, but needing insulin in hospital:

- Day 1: order correctional insulin based on BMI (sensitive = BMI<25, average = BMI 25-30, resistant = BMI>30)
- Day 2: if BG pre-meals are >150 mg/dL, add nutritional insulin based on meal consumption (see above). Also, if AM fasting BG is >150 mg/dL, add bedtime basal insulin dosed 0.1 unit/kg.
- Day 3: adjust insulin doses based on BG pattern. Increase or decrease basal insulin based on AM fasting BG, and adjust nutritional insulin based on pre-meal BG levels. Approximately half the daily dose should be given as basal insulin, and the other half as divided doses with meals.

Insulin regimen for a patient on oral agent(s) at home:

- Day 1: start nutritional insulin based on meal consumption (see “Nutritional insulin” above). Also, order correctional insulin based on BMI (see “Correctional insulin” above).
- Day 2: if AM fasting BG is >150 mg/dL, add bedtime basal insulin dosed 0.1 unit/kg.
- Day 3: adjust insulin doses based on BG pattern. Increase or decrease basal insulin based on AM fasting BG, and adjust nutritional insulin based on pre-meal + bedtime BGs.

Insulin regimen for a patient on insulin at home:

- Assess home BG control, appetite, renal function, and risk for hypoglycemia.
- Basal insulin: continue home regimen if patient has been well-controlled at home, but consider giving only 80% of home dose to reduce the risk of in-hospital hypoglycemia. Or, start bedtime glargine or NPH dosed 0.2 units/kg.
- Nutritional insulin: order based on appetite, or consider pre-meal dosing of 0.2 units/kg divided by 3 for the dose at each meal.
- Correctional insulin: order based on total insulin dose or BMI.

Insulin regimen when a patient is made NPO for a procedure: a patient will always require his or her basal insulin, even while NPO, and should not become hypoglycemic if that basal is dosed appropriately. For safety purposes, however:

- The night before, give the usual dose of bedtime NPH, or decrease the usual dose of bedtime glargine by 25%.
- The morning of the procedure decrease the usual dose of morning NPH by 50%, or decrease the usual dose of morning glargine by 25%.
- Stop nutritional insulin (while patient is not eating), but continue the usual correctional insulin.

Insulin regimen for an ICU or surgical patient who is NPO: consider insulin infusion therapy. See your hospital-specific standardized protocol.

Insulin regimen for a patient starting continuous tube feeds:

- Consider insulin infusion therapy. See your hospital-specific standardized protocol.

- Estimate the tube feed formula's 24-hour carbohydrate load (discuss with nutritionist).
- Estimate the total daily dose (TDD) of insulin, starting with 1 unit insulin for every 10 grams of carb.
- Basal need: divide the estimated TDD by 2 for the nightly glargine or total bid NPH dose.
- Nutritional insulin: divide the estimated TDD by 10 for the total nutritional dose, to be given q 4 hours (rapid acting insulin) or q 6 (regular insulin) hours.
- Correctional insulin: order based on total insulin dose or BMI.

Insulin regimen for a patient receiving TPN:

- Standard TPN often contains 25% glucose, which, if 100 ml/hour, yields 25 g glucose/hour; discuss with nutritionist to determine exact glucose load.
- Basal and nutritional insulin: adding insulin to the TPN can be a safe strategy, as the unexpected discontinuation of TPN will also mean the discontinuation of the insulin. Start with 0.1 unit per gram glucose.
- If the patient has previously required basal insulin, convert this dose to regular insulin and add to TPN (dose reduce to 80% for safety purposes).
- Correctional insulin: order based on BMI.

Insulin regimen to transition from an insulin infusion to subcutaneous insulin:

- Calculate the patient's TDD of insulin, based on the most recent insulin infusion rate. For safety purposes, take 80% of that dose.
- Basal need: divide 80% of the TDD by half for basal insulin dose.
- Nutritional insulin: if the patient is eating, divide 80% of the TDD by half, and then split over three meals. If the patient is receiving tube feeds, divide 80% of the TDD by 10 for the nutritional dose, to be given q 4 hours (rapid acting) or 6 hours (regular).
- If the patient is not receiving nutrition, do not order nutritional insulin.
- Correctional insulin: order based on total insulin dose or BMI.
- Give the first basal insulin SQ injection 1-2 hours before the infusion is discontinued. If the transition is being made in the morning, consider using a one-time AM NPH injection or $\frac{1}{2}$ of daily glargine dose to bridge until bedtime glargine or NPH begins.

Insulin regimen for a patient receiving steroids:

- Glucocorticoids will dramatically increase postprandial BG levels. Often, BG levels are very high during the day while steroids are active, then lower overnight.
- Anticipate post-prandial hyperglycemia by increasing the nutritional insulin doses.
- With glucocorticoids, give only 25% of TDD as basal insulin and 75% as pre-meal insulin.

Insulin Adjustments

- There are no validated formulas for making these adjustments, but the following are generally accepted rules of thumb.
- Basal insulin: adjusted based on fasting glucose (FBG) levels. For example:
- If FBG <140, no change.

- If FBG 141-160, increase basal dose by 2-3 units.
- If FBG 161-180, increase basal dose by 4-5 units.
- If FBG 181-200, increase basal dose by 6-7 units.
- If FBG >200, increase basal dose by 8 units.
- With this approach, the basal insulin can be titrated up to the patient's actual requirement relatively quickly.
- Nutritional insulin: the adequacy of the nutritional insulin dose is based on the glucose level prior to the next meal. For example, the glucose level just before lunch will indicate whether the insulin given at breakfast was appropriate. A simple approach is as follows:
 - If there was no significant change in the glucose level from before breakfast to before lunch, then the total dose of insulin the patient received at breakfast (nutritional plus correctional) should be used as the nutritional dose for breakfast the next day.
 - If there was a significant increase in the glucose level from before breakfast to before lunch, then the total dose of insulin the patient received at breakfast (nutritional plus correctional) should be increased and should become the nutritional dose for breakfast the next day.
 - If the glucose level before breakfast was high, and the glucose level at lunch was at goal, then no change in the nutritional dose will be required for the next day.
 - Finally, no matter what the glucose level was at breakfast, if the glucose level after breakfast or before lunch was low, then the breakfast nutritional dose should be decreased for the next day.

Reference: Hospitalist Handbook

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